

THE DISTRIBUTION OF DWARF MISTLETOES,
ARCEUTHOBIUM, IN CALIFORNIA

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There has long been need of a more careful geographical study of the western dwarf mistletoes than has been available thus far. This paper attempts, first of all, to correct certain misconceptions which have been carried along in the relevant literature. Secondly, it represents an effort to bring up to date what is reliably known about the distribution of dwarf mistletoes in California. Finally, it tries to discover whether there is geographical evidence for the existence of host forms in *Arceuthobium campylopodum* Engelm.

The California distribution of dwarf mistletoes is indeed of crucial importance in geographical considerations in the genus as a whole. For it is in this state that the Pinaceae, a family embracing all known hosts of North American dwarf mistletoes, reaches a high level of diversity. The geographic peculiarities of the genus in California may thus contribute to the understanding of similar features elsewhere.

The lists and maps contain all Californian collections of *A. americanum* Nutt. ex Engelm. and *A. douglasii* Engelm. which I have been able to find in the herbaria of the University of California at Berkeley and Los Angeles (UC and LA, respectively), the California Academy of Sciences at San Francisco (CAS), the Dudley Herbarium of Stanford University (DS), the two herbaria at Claremont (POM and RSA), the Santa Barbara Museum of Natural History (SBM), and the United States Department of Agriculture Forest Pathology herbaria at Albuquerque (FPA) and Berkeley (FPB). Such an approach is at this time not feasible for *A. campylopodum*, as hundreds of collections of this species have been made in California. I have chosen instead to select a number of collections of this species to be recorded here. This selection has been carried out with two objectives in mind: firstly, to give as extensive a picture of the distribution of *A. campylopodum* in the state as possible; and secondly, to compare the geographic ranges of the supposed host forms of this species. Such a procedure does not give a reliable idea of frequency of occurrence. This would have been equally true, however, had all collections been taken into account, because some recreational areas are represented in herbaria by disproportionately large numbers of collections. This is true particularly for the Monterey Peninsula. In a similar way, the mistletoe on digger pine is much more accessible and much more in evidence than, for example, the same species on sugar pine, and therefore the former is present in herbaria in numbers exaggerating its relative frequency. I believe therefore that selection of specimens, when based on some acquaintance with the species as they occur in nature, in this way can give a somewhat more accurate idea of geographic distribution. I am also refraining from citing specimens

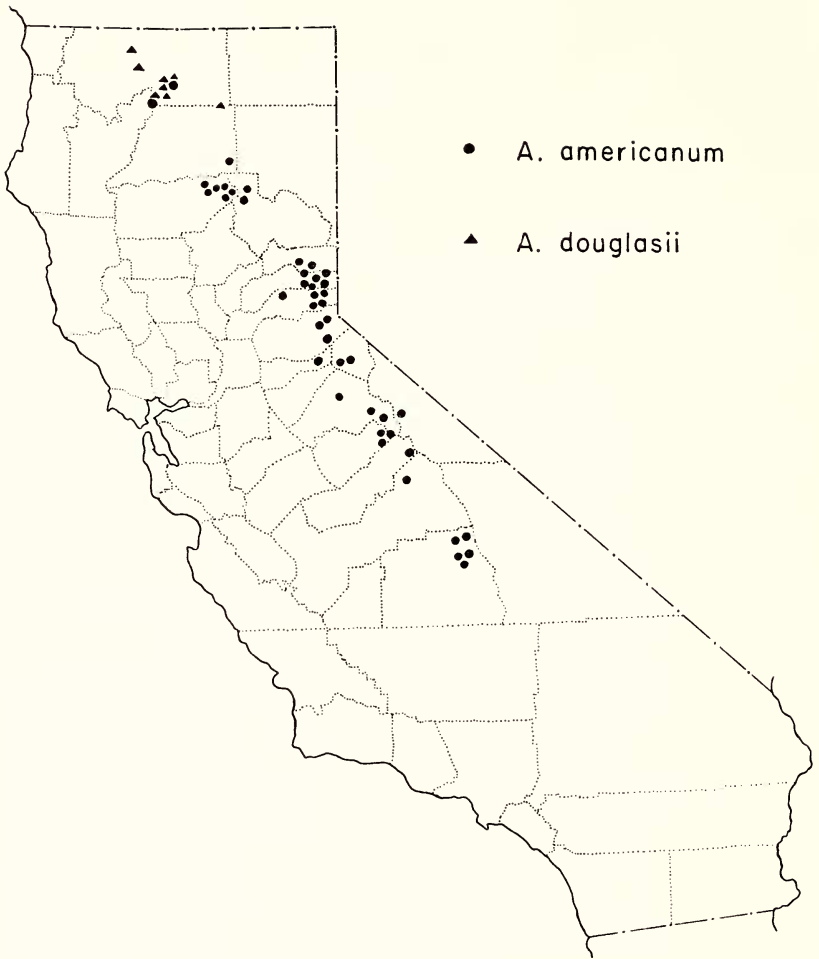


FIG. 1. Distribution of *Arceuthobium americanum* and *A. douglasii* in California.

which I have not personally seen. Especially in Gill (1935) some additional citations may be found which do not, however, modify the distributional patterns as here described, except where this author has repeated erroneous records from previous publications.

ARCEUTHOBIUM AMERICANUM Nutt. ex Engelm.

The lodgepole pine mistletoe is known from the boreal forests of the four western Canadian provinces and from all states west of the Rocky Mountains. It has been collected from a number of pines as well as from *Picea glauca* (Moench) Voss (Kuijt, 1955), but in California it is known from only *Pinus contorta*, *P. ponderosa*, and *P. jeffreyi* (see map, fig. 1).

On *Pinus contorta* Dougl. ex Loud.

TULARE COUNTY. North fork of Kern River, 2150 m., *Coville & Funston 1596* (DS); Bakeoven Meadows, 8100 ft., *Howell 27038* (CAS, DS, UC); ridge between Monache Meadows and Bakeoven Meadows, 8200 ft., *Munz 15220* (RSA); Funston Camp, Kern River Canyon, 6700 ft., *Peirson 1720* (RSA); Junction Meadows, Kern River, 8000 ft., *Raven 8349* (CAS, UC). FRESNO COUNTY. Huntington Lake, 7000 ft., *Solbrig 2420* (UC). MADERA COUNTY. Red's Meadows to Rainbow Falls, 7100 ft., *Raven 3678* (CAS, RSA). MARIPOSA COUNTY. Merced Lake trail, Yosemite National Park, *Schreiber 1948* (UC); Little Yosemite Valley, *Bolander 5095* (UC), *Rodin 877* (UC). TUOLUMNE COUNTY. Glen Aulin Camp, *Baldauf* (CAS); Morrison Creek, Mount Adams, *Bræckett* (LA); YMCA camp, Pinecrest, 5500 ft., *Gill* (FPA). MONO COUNTY. 4.3 mi. west of Highway 120-395 junction, *Kuijt 1390* (UC). ALPINE COUNTY. Camp Wolfeboro, *Kuijt 1411* (UC); 0.5 mi. east of Grade Summit, *Kuijt 1412* (UC). AMADOR COUNTY. East of Lower Bear River Reservoir, *Quick 54-88* (CAS). EL DORADO COUNTY. Near Lily Lake, Glen Alpine Canyon, *Abrams 12753* (DS, RSA, UC); 16 mi. south of Tahoe City, *Kuijt 1335* (UC); Highway 50 at Pyramid Creek, *Kuijt 1513* (UC). PLACER COUNTY. 8.5 mi. west of Soda Springs, *Kuijt 1330* (UC); 10 mi. north of Tahoe City on Highway 89, *Kuijt 1331* (UC); 3.5 mi. north of Tahoe City on Highway 89, *Kuijt 1332* (UC); Tahoe Meadow, *Schreiber 776* (UC). NEVADA COUNTY. Near Donner Lake, *Dudley* (DS); Mayen's Meadow, near Truckee, *Sonne* (UC); Trout Creek near Truckee, *Thomson* (CAS); Truckee, 6300 ft. (FPA); Hobart Mills (FPA). SIERRA COUNTY. 9.5 mi. north of Truckee, *Kuijt 1344* (UC); Salmon Lake, *Sutcliffe* (CAS); Gold Lake (FPA). PLUMAS COUNTY. 18 mi. north of Greenville on Highway 89, *Kuijt 1350* (UC); Gold Lake, *Mason 1079* (UC). TEHAMA COUNTY. 7 mi. west of Highway 36-89 junction at Lake Almanor, *Kuijt 1352* (UC); 13 mi. west of Highway 36-89 junction at Lake Almanor, *Kuijt 1354* (UC); near Ranger Station, Mineral Campgrounds, *Kuijt 1358* (UC); along Deer Creek, 1.5 mi. south of Highway 32-36 junction, *Kuijt 1501* (UC); Spring camp near Childs Meadow, *Quick 53-129* (CAS). SHASTA COUNTY. Thousand Lake Basin, 6400 ft., *Peirson 10136* (RSA). SISKIYOU COUNTY. Military Pass, Mount Shasta, *Cooke 16034* (DS, UC); north fork, Sacramento River, 6600 ft., *Raven 10456* (CAS).

On *Pinus jeffreyi* Grev. & Balf.

PLACER COUNTY. 9.2 mi. north of Tahoe City on Highway 89, *Kuijt 1343* (UC).

On *Pinus ponderosa* Dougl. ex Laws.

TEHAMA COUNTY. 13 mi. west of Highway 36-89 junction at Lake Almanor, *Kuijt 1355* (UC).

DISCUSSION. California represents one of the two southernmost extensions of the lodgepole pine mistletoe, the other being in the Rocky Mountain area of Colorado. From a comparison of Figure 1 with the known distribution of *Pinus contorta* (Critchfield, 1957, fig. 26), it is evident that at least in California the geographic range of the lodgepole pine mistletoe corresponds rather closely to that of its most common host. The exceptions to this rule are seen in the isolated and apparently healthy populations of lodgepole pine in the San Bernardino and San Jacinto mountains, California, and in Baja California, Mexico, and of *P. contorta* subsp. *bolanderi* (Parl.) Critchf. on the Mendocino coast of California. It is also notable that the subsp. *contorta*, although in direct contact with subsp. *murrayana* (Balf.) Critchf. in northern California, has not yet been reported as host for *Arceuthobium americanum*. Indeed this appears

to be true outside the state, as I have seen no record of *A. americanum* anywhere in the range of *Pinus contorta* subsp. *contorta* (Kuijt, 1956). This is more likely to be a case of ecological or spatial isolation than resistance on the part of the host, as various other species of pine and even a spruce may be parasitized by *Arceuthobium americanum*. Furthermore, all subspecies of *Pinus contorta* are susceptible to *Arceuthobium campylopodum* in one or more localities.

It is a remarkable fact that *A. americanum* appears to be unable to perpetuate itself for long periods of time in stands of *Pinus jeffreyi* and *P. ponderosa*. Wherever infected individuals of these hosts are found, infected lodgepole pine is nearby and almost surely is the source of the former infections. This is the more remarkable because the brooming induced on Jeffrey and ponderosa pine is almost identical to that on lodgepole pine (Kuijt, 1958). There are factors quite apart from symptomatology, therefore, which distinguish the spread of this species of dwarf mistletoe in stands of various pine species. Whether these factors are climatological, or whether in Jeffrey and ponderosa pine there is a greater percentage of resistant trees, is impossible to say at present.

ARCEUTHOBIUM CAMPYLOPODUM Engelm.

This species is the most abundant one in California (see map, fig. 2). Outside the state it is found from Alaska and British Columbia, largely west of the Rocky Mountains, to the Mexican border (and across into Baja California). It parasitizes species of *Abies*, *Larix*, *Pinus*, *Picea*, and *Tsuga*. All but *Larix* have been reported as hosts for *Arceuthobium campylopodum* in California, but in greatly different frequencies.

I have attempted, both in the listing and mapping of the specimens selected for my purpose, to group herbarium specimens according to the affinities of their hosts. In this way I have used the following host categories as criteria for division: *Abies*; *Picea*; *Tsuga*; and the three main subdivisions of *Pinus*, namely, the yellow, white, and pinyon pines. I want to make clear that such a subdivision is not based on my acceptance of the corresponding host forms as recognized by Gill (1935), but rather is an effort to test their validity.

On *Abies*.

TULARE COUNTY. Cone Peak Camp, Kaweah and Kings River, *Dudley* (DS); between Junction Meadows and the hot springs, 7500 ft., *Raven 8381* (CAS). FRESNO COUNTY. Charlotte Creek, Bubbs Creek, *Howell 15674* (CAS); 2 mi. south of summit of Shaver Lake-Dinkey Creek road, *Quick 53-27* (CAS); Huntington Lake, 7000 ft., *Wall 67* (CAS). TUOLUMNE COUNTY. Southeast of Strawberry Lake, 6500-7200 ft., *Quick 1734* (CAS); southeast of Pinecrest, *Quick 50-40* (CAS); Tuolumne Canyon, *Clements* (CAS). AMADOR COUNTY. East of Lower Bear Reservoir, *Quick 54-87* (CAS). ALPINE COUNTY. Silver Creek, east side of Ebbetts Pass, 6800 ft., *Howitt* (CAS). EL DORADO COUNTY. Near north end of Echo Lake, *Howell 22902* (CAS); near Camino, *Kuijt 1272* (UC); Tehoma, Lake Tahoe, *Kuijt 1340* (UC). PLACER COUNTY. Trail to Mount Ellis above Homewood, *Schreiber 891* (UC). NEVADA COUNTY. Baltic Trail, *Dudley* (DS). PLUMAS COUNTY. Taylorsville, *Clements* (CAS); 8 mi. north of Greenville, *Kuijt 1349* (UC). BUTTE COUNTY. Jonesville, 1600 m.,

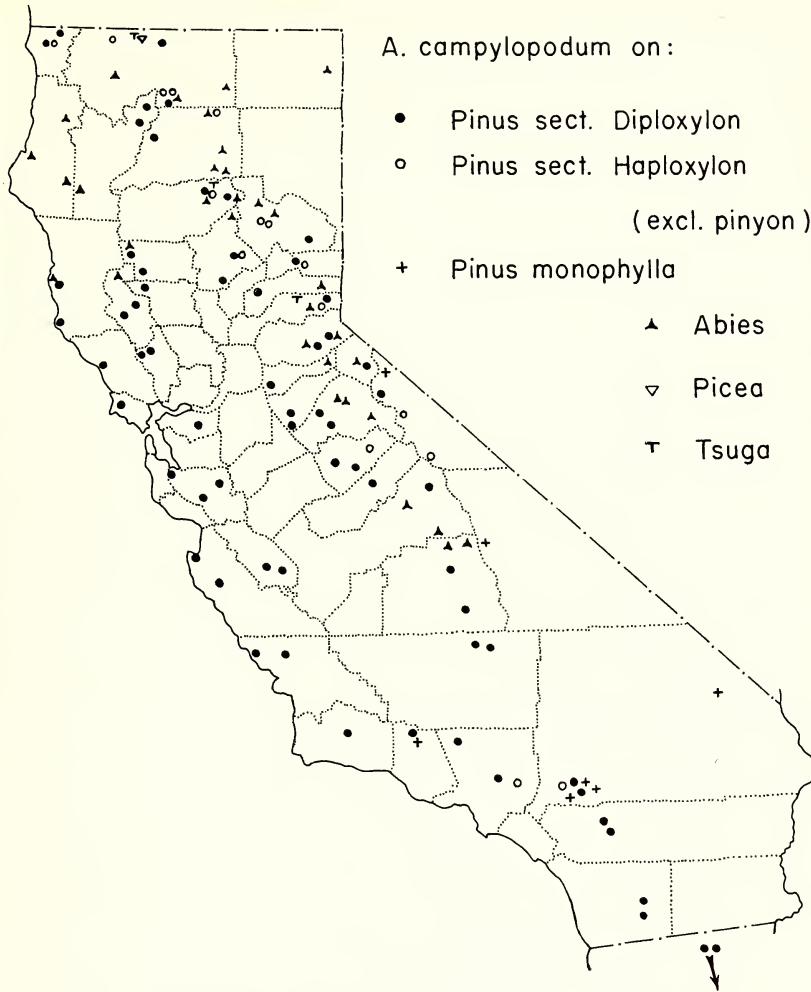


FIG. 2. Distribution of *Arceuthobium campylopodum* in California.

Copeland (CAS). TEHAMA COUNTY. 11 mi. west of Highway 36-89 junction at Lake Almanor, *Kuijt 1353* (UC); 5 mi. west of Mineral, *Kuijt 1359* (UC). SHASTA COUNTY. Highway 89 at Pondosa junction, *Kuijt 1368* (UC); 1.5 mi. east of Viola, *Kuijt 1364* (UC). LASSEN COUNTY. 1 mi. below Drakesbad, Mount Lassen, 5400 ft., *Cain 114* (DS); Crater Mountain, ca. 15 mi. west of Eagle Lake, 7300 ft., *Whitney 1703* (UC); MODOC COUNTY. Campgrounds at Cedar Pass, Warner Mountains, *Alava* (UC). SISKIYOU COUNTY. East of Bartle, at border of Modoc National Forest, *Newcomb 156* (UC); Sisson southern trail, Mount Shasta, *Cooke 13574* (DS); summit of Cayenne Ridge, near Marble Mountain, *Owney 2212* (CAS, DS). HUMBOLDT COUNTY. Lasseck's Peaks, between Goat Camp and Signal Peak, *Kildale 2634* (DS); ridges east of Corral Prairie, Trinity Summit, *Tracy 10571* (UC); Eureka, *Tracy 3984* (UC). TRINITY COUNTY. South Fork Mountain, *Parks & Tracy* (UC). MENDOCINO COUNTY. Van Damme State Park, *Kuijt 1216* (UC). GLENN COUNTY. Plaskett Meadows, 6000 ft., *Howell 19283* (CAS). LAKE COUNTY. *Mackie* (UC): see the discussion under *A. douglasii*.

On *Picea breweriana* Wats.

SISKIYOU COUNTY. Ridge above Applegate Creek, Dry Lake Lookout, 6500 ft., *Meinecke* (FPB).

On *Tsuga mertensiana* (Bong.) Carr.

PLACER COUNTY. Emigrant Gap, *Jones* (POM). TEHAMA COUNTY. Mineral, 6300 ft., *Long* (FPB). SISKIYOU COUNTY. Along head of Applegate Creek, north side of pass to Fort Gough, 6000 ft., *Meinecke* (FPB).

On Yellow Pines. (*Pinus* sect. *Diploxylon*: *P. attenuata* Lemmon, *P. contorta*, *P. jeffreyi*, *P. ponderosa*, *P. coulteri* Don, *P. sabiniana* Dougl. ex Don, *P. radiata* Don, *P. muricata* Don.)

BAJA CALIFORNIA, MEXICO:¹ Low hills northwest of La Encantada, Sierra San Pedro Mártir, 7300–7400 ft., *Wiggins & Demaree 5018* (DS, UC, LA); “San Pedro Mártir”, *Brandegge* (UC). CALIFORNIA: SAN DIEGO COUNTY. Pine Hills, near Julian, ca. 4250 ft., *Brown* (RSA); base of Stonewall Peak, *Wiggins 2725* (DS). RIVERSIDE COUNTY. Idyllwild-Banning, *Clokey & Anderson 6574* (RSA, UC); south side of San Jacinto Mountains, 5400 ft., *Hall 2616* (UC). SAN BERNARDINO COUNTY. Mill Creek, *Smith 15A* (UC); Lake Arrowhead, *MacFadden 14737* (CAS). LOS ANGELES COUNTY. Elizabeth Lake Canyon, Liebre Mountains, *Dudley & Lamb 4411* (DS); Pine Flats, 20 mi. north of Sierra Madre, Angeles N.F., 6000 ft., *Sloan* (FPB). VENTURA COUNTY. Mount Pinos, *Hall 6642* (UC). SANTA BARBARA COUNTY. Figueroa Mountain, *Pollard* (CAS). KERN COUNTY. Near Havilah, 900 m., *Coville & Funston 1073* (DS); 4 mi. west of Kernville, 4000 ft., *Gould 1010* (DS). SAN LUIS OBISPO COUNTY. Cambria, *Hoover 6448* (CAS); Santa Margarita, *Mason 525* (UC); near Paso Robles, *Summers 926* (UC). TULARE COUNTY. Near Mineral King, 2700 m., *Coville & Funston 1460* (DS); Peppermint Valley, *Dudley* (DS). FRESNO COUNTY. Vermillion Valley, 7700 ft., *Raven 5825* (CAS). SAN BENITO COUNTY. On ridge above New Idria reservoir, *Kuijt 1310* (UC); on road to New Idria, 4.5 mi. south of Bitterwater junction, *Kuijt 1300* (UC). MONTEREY COUNTY. Pacific Grove, *Coleman* (DS); Millers Canyon, Santa Lucia Mountains, 4300 ft., *Ferris 12158* (DS). SANTA CLARA COUNTY. Loma Prieta, *Dudley* (DS); slopes of Mount Umunhun, *Ferris 2083* (DS); Arboretum, Stanford University, *Long* (DS).² CONTRA COSTA COUNTY. Mount Diablo, *Abrams 4356* (DS). MADERA COUNTY. Ca. 9 mi. west of Oakhurst, *Kuijt 1254* (UC). MARIPOSA COUNTY. Ca. 3 mi. west of Mount Bullion, *Kuijt 1253* (UC); on road to Wawona, *Jussell 13* (UC). TUOLUMNE COUNTY. Cottonwood Meadows, east of Mather, *Clausen 1777* (DS); near Pinecrest, *Quick 55–46* (CAS). CALAVERAS COUNTY. West of Stanislaus River on road from Vallecito to Columbia, *Quick 53–141* (CAS); 1.5 mi. east of Copperopolis on Highway 4, *Kuijt 1410* (UC). AMADOR COUNTY. On road to Buena Vista, ca. 1 mi. south of Ione, 400 ft., *Newcomb* (UC). MONO COUNTY. 3 mi. east of Sonora Pass, *Kuijt 1432* (UC). ALPINE COUNTY. Silver Creek Public Camp, *Munz 21347* (RSA). EL DORADO COUNTY. Lily Lake, Glen Alpine Canyon, *Abrams 12752* (DS); near Camino, *Kuijt 1273* (UC). PLACER COUNTY. 1 mi. north of Tahoe City on Highway 89, *Kuijt 1333* (UC). NEVADA COUNTY. Spenceville, *Eastwood 3420* (CAS). SIERRA COUNTY. Gold Lake, *Barker 254* (DS). BUTTE COUNTY. Hills near Big Chico Creek, east of Chico, *Heller 11144* (DS); Bangor, *Rose* (CAS). PLUMAS COUNTY. 21.5 mi. north of Sierraville, *Kuijt 1346* (UC). SHASTA COUNTY. Near Morleys, *Baker* (UC). SISKIYOU COUNTY. Sisson southern trail, Mount Shasta, *Cooke 11593* (CAS, DS, UC); west of Craggy Mountain, northwest of Yreka,

¹ As far as I can ascertain, these are the only Mexican records of *A. campylopodum*. The species *A. vaginatum*, which is not known from California or Baja California, does occur in areas of non-peninsular Mexico.

² Introduced into the Arboretum at an early date, since the mistletoe was already there at the turn of the century (Peirce, 1905).

Ownbey & Brown 2425 (UC). DEL NORTE COUNTY. Gasquet Mountain, *Eastwood 12138* (CAS); Elk Camp Ridge, *Parks 24063* (UC). TRINITY COUNTY. Near Scott Ranch, *Cantelow 1659* (RSA); near Trinity Center, *Howell 12790* (CAS). TEHAMA COUNTY. 15 mi. west of Highway 36-89 junction at Lake Almanor, *Kuijt 1357* (UC); Manton, *Kuijt 1362* (UC). MENDOCINO COUNTY. Pygmy forest above Van Damme State Park, *Kuijt 1215* (UC); Point Arena, *Mason 7168* (UC). GLENN COUNTY. .5 mi. above Long Point Fire Lookout Station, 3750 ft., *Newcomb 148* (UC); 2.1 mi. north of Stonyford, *Kuijt 1506* (UC). LAKE COUNTY. Kelseyville, *Jussell* (CAS); near Lucerne, *Sutcliffe* (CAS). COLUSA COUNTY. Stonyford-Upper Lake road, below Old Mill Campgrounds, 3700 ft., *Newcomb 146* (UC). NAPA COUNTY. Mount St. Helena, *Howell 2204* (CAS); 3 mi. from Aetna Springs on Butts Canyon Road to Middletown, *Howell 5618* (CAS). SONOMA COUNTY. Fort Ross, *Mason 4285* (UC). MARIN COUNTY. Inverness Ridge, *Howell 19686* (CAS).

On *Pinus monophylla* Torr. & Frém.

SAN BERNARDINO COUNTY. East slope of Providence Mountains, *Munz, Johnston & Harwood 4272* (POM); north slope of San Bernardino Mountains, *Parish & Parish 1442* (DS, UC); Arrastre Creek, 3 mi. southeast of Baldwin Lake, 6700 ft., *Jaeger* (POM); 5 mi. southeast of Ivanpah, *Gill & Wright* (DS). VENTURA COUNTY. Seymour Creek, Mount Pinos, 6000 ft., *Peirson 3251* (POM, RSA). INYO COUNTY. Ca. 3 mi. west of Lone Pine on Mount Whitney road, *Kuijt 1389* (UC). MONO COUNTY. 6 mi. south of Coleville, *Kuijt 1413* (UC).

On white pines, excluding pinyon (*Pinus* sect. *Haploxyylon*, excl. pinyon: *P. albicaulis* Engelm., *P. lambertiana* Dougl., *P. flexilis* James, and *P. monticola* Dougl. ex Don).

SAN BERNARDINO COUNTY. West slope, Job's Peak, 5000 ft., on *P. lambertiana*, *Ewan 3564* (POM, DS, UC). LOS ANGELES COUNTY. Between Wrightwood and Kratka Ridge, Angeles N. F., on *P. lambertiana*, *Embree* (UC). MARIPOSA COUNTY. Fish Camp Creek, on *P. lambertiana*, *Hedgcock and Meinecke* (UC). MONO COUNTY. On saddle above Convict Lake, 8800 ft., on *P. flexilis*, *Kuijt 1415* (UC); 2 mi. southeast of Lundy Lake, on *P. (?) flexilis*, *Hendrix 616* (UC). PLACER COUNTY. Near Summit, Tahoe N. F., 7500 ft., on *P. monticola*, *Wagner* (FPB). SIERRA COUNTY. Between Downieville and Forest, 5000 ft., on *P. lambertiana*, *Boyce* (FPB). BUTTE COUNTY. Big Bar Mountain ridge east of Pulga, on *P. lambertiana*, *Quick 53-32*. PLUMAS COUNTY. Southeast of Meadow Valley, on *P. lambertiana*, *Quick 53-120* (CAS); Meadow Valley, on *P. lambertiana*, *Weatherby 1667* (UC). TEHAMA COUNTY. 2 mi. north of Hole-in-Ground Campgrounds, on *P. lambertiana*, *Kuijt 1502* (UC). SHASTA COUNTY. Highway 89 at Ponderosa junction, on *P. lambertiana*, *Kuijt 1369* (UC). SISKIYOU COUNTY. North slope of Shastina, on *P. albicaulis*, *Cooke 11576* (DS); west fork of Molly Creek, on *P. albicaulis*, *Butler 272* (UC); head of Applegate Creek, 5800 ft., *Wagner* (FPB). DEL NORTE COUNTY. Gordon Mountain, 4100 ft., on *P. monticola*, *Newcomb 165* (UC).

DISCUSSION. All major areas of yellow pine in California are infected by *A. campylopodum*. This conclusion cannot be avoided when the specimens cited above are considered. There are, however, differences in the frequency of *A. campylopodum* which are not evident from this enumeration. Such differences are difficult to measure, but are nevertheless recognizable in the field.

The only California yellow pine which appears to be free of this mistletoe is *P. torreyana* Parry ex Carr. I have searched for the parasite in the Del Mar area without success, and I have never seen a herbarium specimen with this pine as host. The spatial isolation of this pine from its fellow

species would lead one to conclude that its health is not a question of immunity, but rather that isolation from other pines has, at the same time, kept *Arceuthobium* from reaching the Torrey pine.³ I am currently germinating *A. campylopodum* on some seedlings of this pine, but cannot as yet report on it.⁴

Infected white pines have been collected a great deal less frequently than yellow pines. This is of course partly due to their comparative rarity in the state, especially *P. albicaulis*, *P. flexilis*, and *P. monticola*. *Pinus balfouriana* Grev. & Balf. has also been reported as host from Black Butte, Siskiyou County (Gill, 1935). The latter author also makes reference to a supposed host record of California *P. aristata* Engelm. by Garrett (1921) which, however, is erroneous, as Garrett reports this host only from Bryce Canyon, Utah.

The sugar pine I believe is more frequently infected than the record indicates, and this discrepancy is probably due to the inaccessibility of infections on this tree. It is nevertheless true, as Gill (1935) pointed out, that infected trees of this pine are fairly infrequent and are usually associated with other infected members of the Pinaceae.

The pinyon pines have an even more spotty collection record. This situation indeed is evident in the field since infected trees are rare and appear to occur in small groups. The interesting fact is that such a small number of collections (these are all the pinyon records I have found from California) should be so widely spaced. I have heard it said that the pinyon pine mistletoe is equally spotty in its occurrence outside California.

As far as *Abies* is concerned, it seems to be fairly commonly infected in northern California. The incomplete record for some counties in the Sierra Nevada I suspect to be due to an infrequency of collecting rather than to a rarity of occurrence. This can be checked only by further collections, however. The notable fact in this host genus is that the geographically most isolated fir, *Abies bracteata* (Don) Poit., is free of dwarf mistletoe. Do we here have a parallel to the situation seen in *Pinus torreyana*? Is the lack of infection of *Abies bracteata* due to immunity, or to isolation from dwarf mistletoe? Cross-inoculations may well supply the answer to this question. It is an interesting fact that within a few miles of the *Abies bracteata* populations in the Santa Lucia Mountains the Coulter pine is heavily infected with *Arceuthobium campylopodum*.

There remain to be considered, finally, the only California records known of *A. campylopodum* on *Picea* and *Tsuga*. The small number of

³ Dr. H. L. Mason reports that the pines of Santa Cruz Island are apparently free of mistletoe.

⁴ Since writing the above, the inoculations have been inspected and found successful. The source of the mistletoe seed was Mount Diablo where the dwarf mistletoe grows indiscriminately on both *Pinus coulteri* and *P. sabiniana*. Seeds were placed individually in axils of leaves and fascicles of seedlings of *P. torreyana* (from Del Mar) less than a year of age, on November 6, 1957. At present (January, 1960) a large number of mistletoe shoots are present and one pine has died, perhaps as a result of heavy infection.

collections of these conifers as hosts, and the distances between their localities of origin, would certainly militate against basing host forms upon these genera. The three isolated collections on Mountain Hemlock are significant in this respect, but the infected *Picea breweriana* in Siskiyou County is an even better case in point. According to Gill (1935), the nearest known infected spruces are from Idaho and Arizona!

How then does the geographical evidence bear upon the status of the host forms of *Arceuthobium campylopodum*? It is quite clear that it does not, in itself, support the notion. The host forms considered by Gill as "minor" forms [f. *cyanocarpum* (Nelson) Gill, f. *blumeri* (Nelson) Gill, and f. *microcarpum* (Englm.) Gill] are found within the areas occupied by even a single "major" form, f. *campylopodum*. In fact, f. *campylopodum* is known from practically every county where any of the other forms have been collected. Gill admits that his three "minor" forms are found only in association with other infected species. In California, at least, the host forms do not have geographic independence. These facts alone, of course, do not preclude racial differentiation as to hosts.

It is a common field experience to find a heavily infected species of one tree together with another species, apparently healthy here, but infected elsewhere. This puzzling situation is frequently observed in mixed fir and pine stands of the Sierra Nevada and elsewhere. It seems to me that such situations more than any other considerations have led to the supposition of host forms. In my opinion the taxonomic recognition of such host forms ignores two important possibilities. First of all, it fails to take into account a possible variation in susceptibility even *within* a host species. Secondly, it largely ignores those isolated but significant instances where, for example, a lodgepole pine has become infected obviously from the heavily infected fir towering above it. When geographic data are thus considered together with the results of the past cross-inoculations (Weir, 1918) and natural apparent transfers between *Pinus*, *Picea*, *Abies*, *Larix*, and *Tsuga* (Kuijt, 1955) it becomes evident that the host forms are not natural groups and are, indeed, misleading. The species *A. campylopodum* cannot, in my opinion, be subdivided into natural groups until more is known about the resistance differences (if any) both between and within host species.

ARCEUTHOBIMUM DOUGLASII Engelm.

The Douglas fir mistletoe is the rarest of California dwarf mistletoes (see map, fig. 1). Its range outside the state shows similarities to that of *A. americanum*. It is found from southern British Columbia to California and Arizona and New Mexico. It is not known from the coastal areas of the Pacific Northwest, even where the Douglas fir reaches its maximum development. It rarely grows on anything but Douglas fir (*Pseudotsuga menziesii*), the only known host from California.

On *Pseudotsuga menziesii* (Mirb.) Franco.

SHASTA COUNTY. Highway 89 at Pondosa junction, 4000 ft., *Kuijt 1367* (UC).
SISKIYOU COUNTY. Southwest slopes of Mount Shasta, 5000 ft., *Cooke 13920* (LA);

north side of Cascade Gulch, Mount Shasta, 5000 ft., *Cooke 17729* (CAS); near Upton, Mount Shasta, 4000 ft., *Hall & Babcock 4078* (UC); 1 mi. east of Highway 89-99 junction, *Kuijt 1371* (UC); road to Gumboot Lake, south fork of Sacramento River, west of Shasta, 4500 ft., *Smith & Bacigalupi* (UC); west fork of Cottonwood Creek, Siskiyou Mountains, *Wheeler 2783* (CAS, POM, LA); 2 mi. below Dry Lake Lookout, Oak Knoll Ranger Station, 5000 ft., *Gill* (FPA).

DISCUSSION. So much confusion exists as to this species in California that it is necessary first to make a few corrections.

To begin with, there is the question of Jepson's (1923) reference to *Arceuthobium douglasii* on *Pseudotsuga macrocarpa* (Vasey) Mayr in southern California. As far as I can discover there is no voucher for this suggestion in the Jepson Herbarium or in the University of California Herbarium at Berkeley, or elsewhere. In Jepson's field notebooks there is no mention of *Arceuthobium douglasii*. Whatever the statement was originally based on, at present the record is unacceptable.

A second source of confusion has been Jepson's (1914) misquotation of Engelmann (1880). In this work, Engelmann refers to *A. douglasii* var. *abietinum* Engelm. as occurring on *Abies concolor* (Gord. & Glend.) Lindl. ex Hildebr. in Sierra Valley, Sierra County. Jepson, however, simply repeats this locality for *Arceuthobium douglasii*, and this error is perpetuated by Gill (1935). The var. *abietinum* is undoubtedly referable to *A. campylopodum*, as are the early *A. douglasii* var. *laricis* and var. *tsugense*. There is no reliable record of *A. douglasii* (in the modern sense) from Sierra County.

A third error was first introduced by Jepson (1923) and again repeated by Gill (1935). It concerns a specimen collected by Mackie, "Lake Co., Aug. 1902, on *Pseudotsuga taxifolia*." Both Jepson and Gill refer to *Arceuthobium douglasii* in Lake County. Gill's reference is based on the Mackie collection, and Jepson's probably also. The specimen in question (UC 54672) includes some fragmented material, a couple of infected branches of *Abies* sp. [probably *A. grandis* (Dougl. ex Don) Lindl.], and a cone of *Pseudotsuga menziesii*. I have no doubt, both because of the flowering condition of the plants and because of their large size, that the collection is *Arceuthobium campylopodum*, and that the Douglas fir cone was included by mistake.

As it stands, then, *A. douglasii* is known only from the northern part of the state. In fact, the only known collection outside Siskiyou County was made within half a mile of the county line. There is in this species a most striking discrepancy between the geographic ranges of host and parasite. The common Douglas fir may be found in the Coast Ranges as far south as the Santa Lucia Mountains, and in the Sierra Nevada as far south as Big Creek (San Joaquin River), Fresno County. The dwarf mistletoe, almost exclusively restricted to this tree, somehow has not been able to invade large portions of its host's range. Whether these extensive areas of Douglas fir have remained healthy because of spatial isolation, resistance, or climatic barriers, or whether differences in forest composition here play

a decisive role in limiting the spread of *A. douglasii*, are questions which remain to be clarified.

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NUCLEAR CYTOLOGY OF THE CALIFORNIA MOUSE-TAILS (MYOSURUS)¹

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INTRODUCTION

Published accounts of the chromosome numbers in the genus *Myosurus* are limited to three brief reports concerned exclusively with European representatives. In the 1945 edition of the "Chromosome Atlas," a single citation (Gregory, 1941) noted the chromosome number of *M. minimus* as $n=8$. A check of Gregory's paper, however, reveals that *Myosurus* was one of the few genera in the family for which he had no first hand information. Instead, his citation is based upon the work of Mann (1892) and Hocquette (1922), who found $n=8$ and $2n=16$ respectively. The haploid number was published by Mann as a footnote to his figure 5: "Monaster stage of archesporium, with 8 chromatin segments." Hocquette's account was likewise lacking in details, as his study was part of a general survey of the Ranunculaceae.

The third reference to original work is in the 1955 edition of the "Chromosome Atlas." It is of interest to note that here the earlier citations of Mann and Hocquette are dropped in favor of a more recent

¹ Part of a dissertation submitted to the University of California at Berkeley as partial fulfillment of the requirements for the degree of Doctor of Philosophy.